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AGRICULTURAL
Research

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Pioneering

"We believe there is need for the freer play of genius in agricultural research."

Thus Administrator B. T. Shaw recently addressed directors of ARS research divisions in a statement presenting guides for a new venture—*pioneering research laboratories.*

Shaw points out that scientific *facts* and *principles* are the starting points for the imaginative processes that lead to new things and new methods. The thinking, observation, experimentation, and analysis done to establish these facts and principles may be called basic research. Our researchers and advisors alike are convinced that we aren't doing enough of this sort of research, that this deficiency is decreasing our chances of finding lasting answers to many questions.

The new pioneering research laboratories will provide for research that is not aimed at specific, practical problems but rather at discovering facts and principles and developing theory. Only in this way can a scientist have the freedom he needs to follow where the research trail leads and find the unlooked-for. Such work should build a foundation for quick, effective, economic answering of research questions.

These laboratories will provide places where some of our scientists with special aptitudes for basic research can work in an environment exceptionally conducive to intensive exploration of the frontiers of agricultural science.

Persons assigned to pioneering research laboratories will be carefully selected. Research leaders will be persons who are dedicated to basic research—persons of recognized eminence as well as younger persons of great capacity and promise. These leaders will have associated with them the coworkers needed to carry out the research planned and will not be asked to assume any administrative responsibility.

(Basic research on everyday problems will, of course, be continued as an essential part of our regular work.)

The pioneering research laboratories will be announced here as they are established. They may well be one of the most significant developments in agricultural research. They should mean much to researchers and to farmers.

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AGRICULTURAL RESEARCH SERVIC
United States Department of Agricultur

In case of EMERGENCY

We're preparing to meet danger of radioactive fallout and entry or spread of diseases and parasites

PART 1

■ A TEAM OF USDA, State and local specialists around the Nation stands ready to go into action in case of emergency to save our livestock and crops from disease and destruction.

This team now operates on a full-scale, peacetime basis to help prevent any foreign livestock and plant pests and diseases from coming into our country and to control those we already have. It is also set up to slip quickly into high gear in case of biological warfare—deliberate use of disease-producing agents against animals and plants. One of its important new functions is to tell our farmers how to minimize the effects of radioactive fallout on livestock, crops, and farm products (see page 16).

This country has been able to defend itself in past wars because of the production of our farms and factories. In the future, however, an enemy may attempt to weaken or destroy these resources by any means possible. Deliberate introduction of disease as an act of sabotage, for instance, could cripple our livestock and crop industries. That could limit our food supply as well as many of our valuable sources of clothing and medicine.

Enemy could cause confusion

An enemy could select the host, disease, time, and place of outbreak to make animal and plant disease control more difficult and to cause devastating losses. Similar diseases could be introduced at the same time to confuse diagnosis and eradication. It's unfortunately true that some animal diseases—native and foreign, harmless and fatal—have similar symptoms and are difficult to distinguish. Combining different diseases might produce confusing, contradictory signs and different incubation periods.

Our Federal Civil Defense Administration realized the potential threat of deliberately caused animal and plant disease. So, in September 1954, FCDA delegated to USDA the responsibility for protecting our crops and livestock against biological warfare. This job was given to ARS because of the longtime experience of its regulatory personnel in handling cooperative State-Federal operations.

PLANTS AND ANIMALS are inspected (1) to be sure they are disease free before coming into country. Livestock travel so fast that symptoms sometimes show up after animals cross border. Diseases can get past in many ways. Big hazard is intercontinental traveler, who brings home dried-meat delicacies that may be infected with foreign disease. Or he may bring in flower bulbs, chestnuts, pine cones, or garlic—some of which may be diseased or may carry insects or larvae not visible to the naked eye (2). If meat delicacies are not eaten and are thrown into garbage fed to livestock, serious disease can occur. Diseases can also get in via insect vectors trapped in airplanes, or by hurricanes. USDA's land-boundary, ocean, and air ports cover Nation's borders, protect against importation of foreign diseases.

ARS immediately organized a countrywide series of meetings to establish a plan for coping with biological warfare. Participating were State and Federal regulatory officials, representatives of diagnostic laboratories, State agricultural experiment stations, and agricultural and veterinary colleges.

Alert standby force set up

These planners knew that control of biological warfare on livestock meant, basically, control of foreign diseases. Principles of disease control and eradication are the same, whether diseases get in accidentally or deliberately. Thus, planners decided the best way to deal with biological warfare on livestock was to have a well-trained standby force that could be quickly expanded in time of war. With this in mind, a State-Federal Emergency Animal Disease Eradication Organization was set up in most States to deal with dangerous animal diseases of foreign origin.

At the same time, it was decided to utilize existing State-Federal channels to keep out foreign plant pests and diseases. State-Federal cooperation had done a fast and efficient job in cleaning out many serious pests and diseases before they could get a foothold. Planners felt that it would be desirable to strengthen and expand this cooperation and to back it up with more emphasis on reporting plant pests and diseases that we have.

Why is it so important to keep out livestock and plant pests and diseases? And why is it so hard to do?

In the past, we've looked upon many animal and plant pests and diseases as peculiar to Europe, Asia, and Africa. But today's fast intercontinental air transportation and the buildup of trade and travel have given such pests and diseases new importance. These factors, plus our own fast livestock marketing, have greatly increased the danger of accidental and deliberate transmission. Furthermore, we have some 8,000 species of domestic insects competing for our food and fiber. Deliberate spread of foreign plant pests would complicate an already complex problem.

Up till now, time has been on our side. Shipments of livestock by sea took from 15 to 30 days. This period gave most diseases time to develop signs that could be observed. Today, for the first time in history, we are importing more animals by air than by ocean vessel. Animals now arrive in hours instead of days.

Outbreak can spread rapidly

We move animals rapidly within our borders, too. The nationwide outbreak of vesicular exanthema in swine is a forceful example of how fast animal disease can spread. VE was limited for many years to California until 1952, when it escaped via raw garbage sent out of the State. Within 6 weeks, 18 States reported the disease, and a short time later, 13 more (AGR. RES., July 1955, p. 5).

Florida's Mediterranean fruit fly infestation shows how fast plant pests can spread. This serious citrus pest was first brought to official attention in April 1956. By the time State and Federal people were able to get a trapping program into full swing, they found they had over 1,500 infestations of the Medfly spread over 27 counties (AGR. RES., Nov. 1956, p. 5).

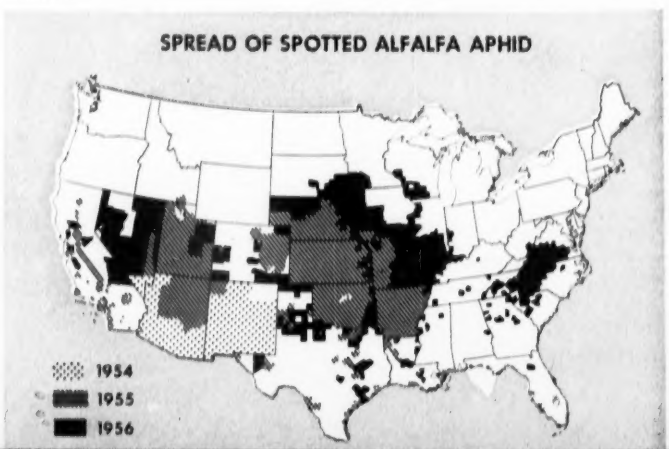
Nationwide training planned

It's apparent that foreign animal or plant pests and diseases getting into this country could quickly become widespread unless we recognize them promptly and take immediate control steps. So emergency planners set up a nationwide training program to instruct personnel to recognize diagnose, and report these threats.

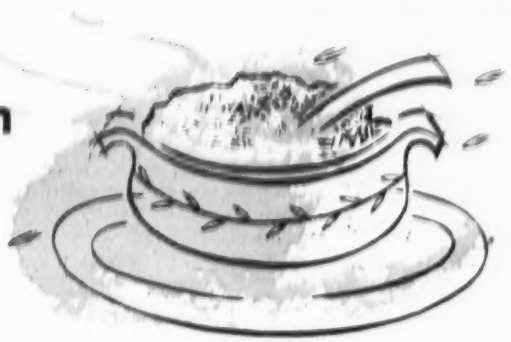
We'll hear first—in the next issue—how the planners are preparing for livestock emergencies. In the following issue, we'll report on their plans to meet plant emergencies. ☆

HOW ANIMAL DISEASE SPREADS: recent check of 3 big stockyards (out of 50 Federally inspected) showed they shipped to or through 40 States, received shipments from 20. Add shipments in and out of hundreds of local yards, large and constant poultry movement, livestock auctions, private sales, shipments of various animals.

HOW PLANT PESTS SPREAD: the spotted alfalfa aphid was at first reported in this country early in 1954. Within 3 years, it had moved into 30 States. One of the fastest spreading destructive pests ever introduced into our country, it has greatly damaged our alfalfa crops. In 1956 alone, damage from the alfalfa aphid was estimated at $42 million.



Now Breeders Can Cook-test RICE



Quality differs in cooked rices of various varieties and in those grown under different environments or cultural methods

■ NEW STANDARDIZED METHODS of evaluating the quality of rice make it possible for breeders and growers to develop rice varieties that are better suited to consumers' tastes.

Heretofore, varieties have been selected mainly on the basis of such qualities as adaptation to climatic conditions, disease resistance, yield, and suitability for mechanical harvesting and artificial drying.

The new methods were devised by researchers in USDA's Institute of Home Economics under direction of ARS food specialist Elsie H. Dawson.

For taste-panel evaluation of the color, cohesiveness, off-flavor, and degree of doneness, 100-gram samples of rice were cooked in a minimum of water, which was all absorbed by the rice during the cooking process.

For small amounts of rice, as in the case of a new variety, physical and chemical tests of quality were made on 8-gram samples cooked in excess water. Determinations included volume and weight of cooked rice, water uptake ratio (water absorbed), pH, amount of amylose starch, and total solids in the cooking liquid remaining after the rice was cooked.

Variety makes a difference

Twenty-six varieties of strains of milled white rice were tested by both methods. The rice, supplied by USDA's Crops Research and Southern and Western Utilization Research and Development Divisions, had been grown in four States under known conditions in 1953, 1954, and 1955.

The tests were designed to show differences among varieties and strains as well as the effects of environment and cultural practices on quality. Researchers used the tests also to compare results of the cooking methods and to see if there were any relationships between palatability factors and objective measurements.

Long-grain varieties tended to absorb more water than other types. As might be expected, the varieties that absorbed more water yielded large volumes of cooked rice. The long-grain rice also tended to be more white and less sticky or cohesive.

Starch losses tend to vary

Although different varieties of rice had approximately the same amount of total starch in the milled grain, they differed in amount of amylose starch in the residual cooking liquid (water remaining after rice was cooked). Long-grain rice tended to have higher amylose starch content in the cooking liquid and lower pH values than medium and short grain varieties that were grown in the same State.

The place where rice was grown seemed to affect its quality. Rices grown in California absorbed less water and had lower cooked volume than comparable lots of the same varieties grown in Texas. The residual cooking liquid contained more total solids and starch and had higher pH values. California rice also tended to be more cohesive or sticky than Texas-grown rice of the same varieties. There were too few samples, however, to draw definite conclusions.

Age, other factors important

Off-flavor was noticeable most often in the older rice. Much rice grown in 1953, for example, was rated in the spring of 1956 as stale, starchy, rancid, or musty in flavor.

Statistical analysis of data from 1955 rice samples showed a highly significant positive correlation between water uptake ratio and cohesiveness; that is, rice that absorbed more water was less cohesive or sticky. Correlation was negative between total solids in cooking liquid and cohesiveness, meaning that rice with more solids in the cooking water was stickier. The correlations between several other measures—such as volume of cooked rice, pH, and starch content of the residual cooking liquid and the eating quality of the cooked rice—were not significant for the number of samples tested.

Further study on a large number of varieties may make it possible to predict the palatability of rice samples from objective measurements. ☆

modernizing

OUR SUGARCANE HARVEST

One operation by new machine saves labor, time, and sucrose

■ A HARVESTER DEVELOPED by USDA for the Louisiana area promises to streamline production of sugarcane, one of our last major crops to come under labor-saving harvest methods.

Modernization of the harvest has been slow for lack of a practical, fast way to defoliate the canes for efficient milling. At present, burning is the most practical way to get rid of the leaves. The sugarcane is cut green and left in the field a few days to dry so it will burn more readily.

To reduce peak labor loads, cane is harvested in three stages: (1) cutting, topping, and heap-rowing, (2) burning, and (3) loading. Some sucrose is lost while the cane lies in the field. It took ingenuity to solve the key problem, defoliation.

A giant-size experimental harvester was developed by ARS agricultural engineer R. M. Ramp and associates at Houma, La. This cuts the standing stalk and places it, topped and stripped of leaves, into a wagon ready to be hauled to the mill. The machine does all this in a few seconds, rather than over the customary 3 to 7 days. Cane loses $4 to $10 in value per acre per day from cutting to milling because of respiration and conversion of the sucrose to a noncrystallizable invert form of sugar.

A two-man crew operating this machine, together with tractor drivers hauling wagons, can do the work of a large harvest crew. The experimental harvester provides a method that will save more sugar per acre than the old, time-consuming method.

The new machine expedites harvest in another way. Its giant tires enable it to operate on a field shortly after rain. Faster and uninterrupted har-

1. Sugarcane harvester developed by ARS engineers cuts, cleans, and loads cane ready for milling in one continuous operation. This self-propelled machine cuts sugarcane at the top and bottom, strips off the leaves, and loads the stalks into an attached wagon. Balloon tires carry the machine well on damp ground, so harvesting can resume shortly after a rain.

3. FLEXIBLE rubber fingers set spirally on a pair of rotating drums beat the leaves off of the stalk as the cane passes through the machine. There are two of these units—one for the bottom half of the stalk and another for the top. Together, they do an excellent job of defoliating the sugarcane and preparing clean, trash-free stalks that permit most efficient sugar recovery in milling.

4. Loaded wagon is dropped at the end of the row by playing out the cable from the harvester winch. Cable hook is transferred by hand to the empty wagon spotted short of the newcut row. The empty wagon is pulled into position for the new run by reversing cable winch on harvester. The exchange can be made speedily without involving excessive maneuvering or use of an extra tractor.

vesting should reduce the hazard of standing or down cane being caught by early freezes, which also reduce the recovery of sugar.

In erect stands, the machine delivered cane with the good average of less than 3 percent trash. Trash ranged up to nearly 10 percent with suckers present. (Trash reduces milling efficiency and sugar recovery.)

The harvester is fairly effective in gathering stalks that lie across the middles, and changes now being made may improve this. But it can't efficiently gather stalks that lie lengthwise of the row. The harvester is not readily adaptable to Florida, Puerto Rico, or other areas that grow recumbent types of sugarcane.

2. Rubber-block transfer, elevating chains (along with upper pair not shown) grip stalks as they are cut and move them in upright position to the rear and through leaf stripper. Cleaned canes move from the upper end of the elevating chain to a loader arm.

The experimental harvester weighs about 15,000 pounds. Further field testing will be done before it is released for commercial production. Ramp estimates it can be made for about $13,000 and would justify the price through harvest economies. ☆

How Much Rent Should Beef Animals Pay?

■ THE MAXIMUM RENT a beef animal should pay, and the most a farmer should spend on buildings, can be figured by a formula developed by USDA in cooperation with Illinois Agricultural Experiment Station.

The formula allows for simple, one-story, open-front shelter barns. These are the most economical type of buildings for sheltering beef animals. Open areas are well suited for removing manure as well as for bringing in power equipment and supplies. Hay and bedding storage is less expensive at ground level than in lofts, and storage in horizontal silos is simpler and more economical than in vertical silos.

Nothing is included for bigness, uniform architecture, and better appearance. ARS agricultural economist R. N. Van Arsdall says this should be charged to personal pride or advertising—not to the cattle.

First step in determining rent per animal is to estimate the average gross return by subtracting original cost from sale cost. If a 500-pound steer bought for 20 cents a pound, or $100, sold for 23 cents a pound at the weight of 1,000 pounds, or $230, the gross is $130.

To figure the annual rent, take 8 percent of the gross. (This 8 percent represents the usual cost of building rent in Midwest beef enterprises.) That would be $10.40 for the portion of annual gross income that could be allotted from each animal for use of the building.

This figure ($10.40 here) represents interest on investment, depreciation, repairs, maintenance, taxes, insurance, and miscellaneous expenses. These costs (taking 8 percent of gross income) usually total 9 percent of the cost of buildings in the original investment.

To find what the maximum original investment should be, divide the annual rent by 9 percent. In this case, $10.40 divided by 9 percent is $116—the amount justified per animal for buildings. This includes such expenses as beef barn with feed storage and yard paving.

The figure represents the maximum allowable for necessary buildings—not necessarily the most economical figure. The formula answer indicates the break-even point and may be used to prevent overspending.

To determine the cost justified for buildings, multiply the number of animals times the amount justified per animal. With 40 animals (times $116), the total is $4,640. The smaller the herd, the more difficult it is to build within the cost indicated by the formula.

Economists warn that errors in estimating future gross income will be reflected in the estimate of how much should be spent for buildings. Unusually high returns from beef animals do not always justify high investment in buildings. If gross income is usually $100, an animal that has a $200 gross income should be figured as $100 when determining building expenditures. A cow that produces a $200 calf does not need twice as much housing as one that produces a calf worth $100.

Researchers suggest listing functions expected from the buildings and studying a variety of plans before constructing livestock shelters. Circulars and plans are available from agricultural colleges. ☆

Raising FRIEND

predators

1. Predators, such as the chrysopid and the lady beetle, are imported from India to feed on the alfalfa aphid. Experiments are under way to find out whether these predators will destroy other insects. Above: lady beetles on clover leaves.

2. The lady beetle lays eggs on these leaves. But the chrysopid must be placed in cylinder-shaped carton lined with brown wrapping paper. Chrysopid lays dozens of eggs, attaching them—with thin but strong filament—to the lined paper.

3. The egg-dotted paper (left) is packed in carton ready for release to field stations. There, paper is pinned to plant leaves and eggs hatch to feed on aphids. Leaves covered with lady beetle eggs (right) also are pinned to infested plants.

parasites

1. A variety of host plants are grown in Moorestown, N. J. This includes tulips and Chinese cabbage (background), raised for green peach aphids. Clover (foreground) grows in dishes of vermiculite for alfalfa aphids. When plants are larger, they are moved to the pots.

6. A cocoon parasite on the right develops within the aphid. The parasite at left is on verge of emerging. Insects are shipped to State and Federal scientists for liberation in research attempts to establish the parasites in alfalfa fields to destroy the aphids.

DLY INSECTS

Scientists are searching out and learning to mass-rear predators and parasites of insects that prey on our crops

■ PARASITES AND PREDATORS—natural enemies of many insects—are reared in Moorestown, N. J., and other USDA laboratories. These beneficial insects are shipped to Federal and State laboratories for experiments on pests that destroy forage, fruit, and truck crops.

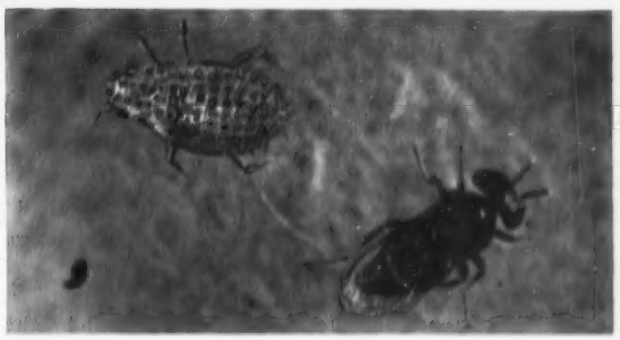
ARS entomologists are fighting destructive insects such as the spotted alfalfa aphid, Rhodes grass scale, pea aphid, and the green peach aphid. The scale attacks 74 species of grass, but mostly Rhodes, Para, Bermuda, Johnson and St. Augustine grass. The pea aphid is a major pest of alfalfa and attacks clover as well as peas. The green peach aphid is a pest of tobacco, spinach, potatoes, mustards, and plants of the cabbage family. Scientists also are trying to combat the bean beetle, European chafer, the apple maggot, and the sweetclover weevil.

Methods of mass-rearing parasites and predators, introduced from Europe and Asia, are under study. Predators feed on the destructive insects. Parasites inject eggs into the nymphs of the damaging insects; then parasites, instead of the destructive adult insects, emerge. ☆

3. Parasites, in glass vials, are introduced to the cages containing the clover-aphid-infested plants. The clover aphids are used because alfalfa aphids do not occur in the New Jersey area at the present time.

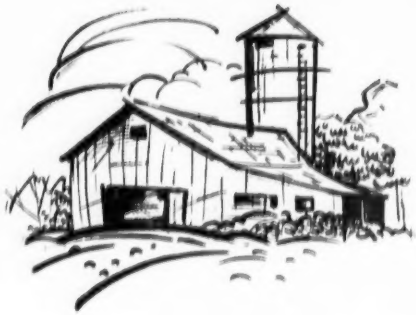
4. Three kinds of parasites are reared for attacking yellow clover aphid and spotted alfalfa aphid. These are the *Aphelinus semiflavus, trioxys utilis,* and *Praon palitans*—all kept at 60° F. until released.

2. Leaves heavily infested with yellow clover aphids are placed on the clover plant—an alternate host for alfalfa. Three days later, some 1,000 aphids are reproduced, caged. (Other destructive pests are similarly reared for predators to feed on and parasites to kill.)



5. A closeup in the cage shows the parasite (the lower insect) approaching an aphid. Parasites oviposit eggs into the aphids. The aphids eventually die; the new parasites later emerge and fly to a screen. Insects are sucked into cartons with hand hairdriers.

BACTERIA AND SILAGE QUALITY



Faulty ensiling methods favor spoilage bacteria that undo good work of the lactic-acid formers

KINDS AND AMOUNTS of fermentation acids produced by bacteria carried on plants at ensiling time are important in determining the quality and feeding value of the silage.

This fermentation is extremely fast. USDA research shows that the final quality of silage may be determined in a few hours after ensiling.

C. W. Langston, Jr., and associates at the Agricultural Research Center, Beltsville, Md., studied the microorganisms and chemical changes at different stages of fermentation in good- and poor-quality orchard grass and alfalfa silage. Excessive temperature was one early symptom of impending spoilage. But even earlier conditions at the time of ensiling (extent of air inclusion or exclusion) seemed to determine whether the silages would be found good or poor in quality.

Packing, quick sealing help

Forage tramped, weighted, and immediately sealed usually made good-quality silage. It heated only moderately as the oxygen-loving bacteria on the plant and the oxidative enzymes in the plant tissue used up the available oxygen within the first 5 hours after ensiling. This is generally considered a much slower process. As conditions became favorable, the lactic-acid bacteria became predominant and converted the sugars present into several effective preservatives—lactic, acetic, and succinic acids.

On the other hand, Langston found that forage spoiled when left loose and unsealed for 2 days, and especially when air was forced through it. It heated abnormally for the first few days and ultimately lost nutrients and much desirable lactic acid.

Harmful spore formers noted

Poorer quality silages always contained the spore-forming anaerobic bacterium *Clostridium tyrobutyricum*, which converts lactic acid into butyric acid. A companion spore former, *Clostridium sporogenes*, was also found in large numbers. It converts proteins into ammonia, hydrogen sulfide, and other offensive substances.

The inferior silages contained anaerobic spore-forming bacteria ranging from a few million up to 10 to 15 million per gram of silage.

Lactic-acid bacteria reached several hundred million per gram of silage in a few days in both good- and poor-quality silages. Fresh forages that had relatively high initial numbers of lactic-acid bacteria were apparently no better in quality than forage with few or none. Therefore, making good-quality silage does not necessarily depend on actions to increase desirable organisms, but rather on actions to prevent the destructive organisms from getting a foothold.

Plant type raises questions

Type of plant used for ensiling was another factor that made a difference in ultimate silage quality. It may come as a surprise that alfalfa consistently made better silage than orchard grass, which usually contains a greater amount of sugar. Another puzzling fact is that alfalfa withstood higher temperatures with lower nutritive loss than orchard grass. The alfalfa also gave lower spore counts than similarly treated orchard grass, and they occurred later in the fermentation process. The significance of these findings isn't fully understood, but their importance is obvious in view of so much current emphasis on use of the protein-rich forages.

Langston isolated from the experimental silages about 4,000 bacterial strains—3,000 resembling the lactic-acid bacteria and 1,000 spore formers. He screened them sufficiently to select 440 representative strains for detailed study. Each strain is identified with the type of forage from which it was isolated, the stage of fermentation, and the quality of the silage. A detailed comparison of organisms from the different quality silages may lead to a better understanding of the underlying mechanisms that presumably govern the quality of silage.

This, along with an intensive study of the initial 48-hour fermentation period in forages, may show the significance of the early sequence of bacterial types that occur in good and poor silages. It would be useful to know, for example, if lower quality silage results when the early lactic-acid producers are predominantly cocci (the spherical forms) rather than bacilli (the rod forms that are generally more efficient.) ☆

Needed: fruit moth spray that spares parasites

■ DEVELOPMENT OF INSECTICIDES that do not affect parasites but control destructive insects is a goal of USDA scientists. They're also hoping to work out better ways of applying present insecticides to avoid harming these beneficial parasites.

Research is under way at the ARS entomology laboratory at Moorestown, N. J., with a major peach pest, the oriental fruit moth. Entomologists want to find an insecticide that controls this and other peach insects but is not toxic to parasites or plants, or dangerous to humans.

And they want to determine if there is a stage in the life of the parasite when it's less susceptible to present insecticides. Experiments are in progress this summer to test the results obtained in last year's studies of the effect of parathion on the oriental fruit moth parasite populations in peach orchards.

Last year, parasites attacking the larval stage of the oriental fruit moth disappeared from peach orchards after parathion had been applied. Within 2 to 3 weeks, however, the parasites were reestablished. Egg parasites disappeared for 3 months—from May through July. Cocoon parasites were eliminated for a week longer than the egg parasites.

The experiments are being repeated this summer. Four orchard plots are being sprayed with parathion and 4 with lead arsenate (lead arsenate has little effect on the oriental fruit moth or its parasites). Some 100,000 oriental fruit moth cocoons, reared on small green apples in the laboratory, are exposed to parasites in the orchards. Lots of 125 cocoons (5 to each 25 trees) are exposed every 7 days from mid-May to mid-August. The cocoons are then returned to the laboratory for observation.

There the degree of parasitization is evaluated on the basis of the number of parasites and moths that emerge from the exposed cocoons.

Oriental fruit moth eggs also are exposed to parasite attack in the orchards. Twigs, each with a peach leaf containing eggs, are placed in vials of water. The vials are fastened to the trees for 2 days, then returned to the laboratory and kept in chambers at 80° F. Immediately after the normal eggs hatch, examination is made with a microscope to learn the degree of parasitization. ☆

Sought: pesticide that won't harm nursery stock

■ A SUBSTITUTE FOR ethylene dibromide in the injection treatment of nursery stock for quarantine certification is being sought by entomologists and chemists at USDA's laboratory in Moorestown, N. J.

Shipments of plants (with roots encased in soil) from regulated parts of 15 States under Japanese beetle quarantine and 3 States under European chafer quarantine are treated to kill grubs present. The approval certificate is then granted by Federal and State officials for movement.

Ethylene dibromide is effective against grubs (AGR. RES., August 1954, p. 13), but may injure plants.

The Japanese beetle and European chafer menace many northeastern plants—demand vigilance by States, USDA, and the public. Freight and rail yards, truck centers, and weighing stations are checked and commercial and military planes and airports are treated in regulated areas in cooperation with State authorities. Control workers search outside the quarantine areas for infestations.

"These precautions must be taken if the beetle and the chafer are to be curtailed," says E. D. Burgess, Chief of the ARS Plant Pest Control Division. "To make control complete, cooperation of the public is needed. Plants and soil as well as agricultural products affected by the insects should be carefully inspected before movement from any infested area."

The chafer was first found in New York in 1940 and later in West Virginia and Connecticut—the three States under quarantine. It attacks pastures, winter grains, and forage crops. The adult does little damage.

Plants and soils are quarantined for the Japanese beetle in Maine, New Hampshire, Vermont, New York, Massachusetts, Connecticut, Rhode Island, New Jersey, Delaware, Maryland, Pennsylvania, Ohio, Virginia, West Virginia, and North Carolina. The beetle feeds on corn, soybeans, grasslands, fruits, ornamentals—in fact, on some 200 plants. It is controlled largely by parasites, and milky disease of grubs (biological technique developed at Moorestown). ☆

WE'RE LEARNING MORE ABOUT *blackhead*

Complicated problem involving a parasite in a parasite may be nearer a solution as a result of research findings

■ BASIC STUDIES ARE helping pinpoint location of blackhead parasites in turkeys. This should lead to timing of drugs to knock out the organisms when they are most vulnerable.

Much of the USDA work on this costly and serious disease is being carried on with a harmless strain of the blackhead parasite. Use of this strain has helped researchers to turn up other new and useful information on disease aspects that are obscure when the disease is severe.

Blackhead is caused by a microscopic parasite—*Histomonas meleagridis*—that attacks the two ceca (blind gut) and liver of turkeys and sometimes chickens. The histomonad spends part of its life in the eggs of the cecal worm—*Heterakis gallinae*—a parasite that's commonly found in the ceca of turkeys and chickens.

Cecal-worm-infected birds pass large numbers of microscopic eggs in their droppings. If the birds have blackhead, these worm eggs may carry histomonads. Turkeys and chickens acquire blackhead by swallowing the infected worm eggs along with soil, feed, or water. Infected turkeys may die in large numbers. Losses result also from slow gains, marketing delays, and carcass downgrading.

Chickens carry the carrier

Chickens are not very susceptible to blackhead but may carry cecal worms, which are parasitized by the histomonads. If chickens and turkeys are raised together, susceptible turkeys can easily acquire blackhead.

Several years ago, ARS scientists at the Agricultural Research Center, Beltsville, Md., found that some of their turkeys had blackhead organisms but showed no symptoms and thrived normally. Variations in virulence of the blackhead parasite had long been recognized, and Beltsville scientists at first thought the strain was merely weakened.

Harmless strain aids study

Research with 600 turkeys and 300 chickens for 3 years proved it was a true—but harmless—strain of the blackhead organism. The only obvious differences are that the harmless form is generally larger and has more flagella (whip-like structures).

Work with this non-pathogenic strain is helping parasitologist Everett Lund and associates to study, among other things, the probable timing of medication in relation to the life cycle of the worm and histomonad.

It's important to know when to treat infected birds, what kind of drugs to use, how to use them, and for how long. For instance, medication can be used to destroy either the cecal worm or blackhead parasite.

To be really effective in controlling blackhead by acting on the cecal worm, drugs must do one of several things: (1) kill the larvae before they get in the cecal membrane, (2) weaken cecal worm eggs so larvae are less viable, (3) toughen cecal worm egg shells so larvae can't get out, or use up their energy in doing so and thus are less viable, or (4) kill the larvae in the cecal wall. The latter might be accomplished by using drugs easily absorbed by the cecal membrane but harmless to birds.

Presently used medication against the cecal worm is partially effective. It keeps the worm from maturing. Although worm numbers are reduced by such treatment, it must be continued for several years in order to eliminate the disease. The hardy cecal worm eggs can survive on or in the soil for as long as 2 or 3 years.

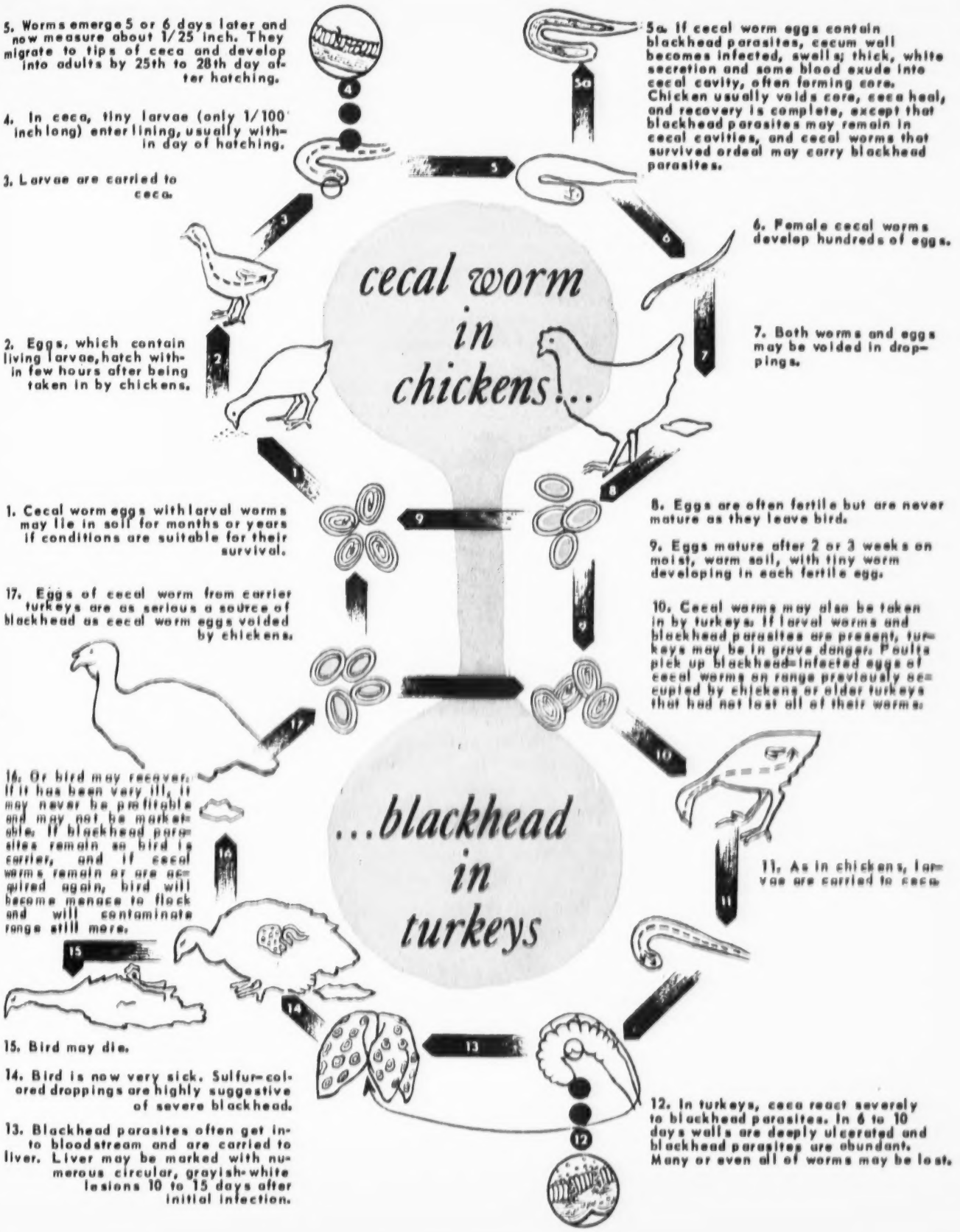
One of Lund's aims is to find out when and how histomonads get into and out of cecal worm eggs. Such knowledge would enable use of drugs at a specific time to destroy the histomonads before they find refuge in the worm eggs or cecal wall.

To get this information, Lund is feeding turkeys worm eggs carrying either no histomonads or only the non-pathogenic strain. After 3 to 6 weeks, pathogenic histomonads are injected rectally. The birds are slaughtered no sooner than 30 days after the first dosage. This allows time for the worms to mature. Then the worms are removed from the ceca and eggs are removed from the worms.

Infection time is narrowed

So far, all eggs collected have either been free of histomonads or have carried only the non-pathogenic histomonads—the kind originally introduced. Lund is gradually narrowing down the time between doses so infection will take place. Thus, he can establish the time the pathogenic histomonads enter the worm egg. Basic information on immunization is also coming out of this work.

Indications are that the histomonad usually leaves the worm egg after the worm enters the cecal membrane. And it looks as if the histomonad is carried within the larval worm—not merely within the egg shell. ☆



5. Worms emerge 5 or 6 days later and now measure about 1/25 inch. They migrate to tips of ceca and develop into adults by 25th to 28th day after hatching.

4. In ceca, tiny larvae (only 1/100 inch long) enter lining, usually within day of hatching.

3. Larvae are carried to ceca.

2. Eggs, which contain living larvae, hatch within few hours after being taken in by chickens.

1. Cecal worm eggs with larval worms may lie in soil for months or years if conditions are suitable for their survival.

17. Eggs of cecal worm from carrier turkeys are as serious a source of blackhead as cecal worm eggs voided by chickens.

16. Or bird may recover. If it has been very ill, it may never be profitable and may not be marketable. If blackhead parasites remain as bird is carrier, and if cecal worms remain or are acquired again, bird will become menace to flock and will contaminate range still more.

15. Bird may die.

14. Bird is now very sick. Sulfur-colored droppings are highly suggestive of severe blackhead.

13. Blackhead parasites often get into bloodstream and are carried to liver. Liver may be marked with numerous circular, grayish-white lesions 10 to 15 days after initial infection.

12. In turkeys, ceca react severely to blackhead parasites. In 6 to 10 days walls are deeply ulcerated and blackhead parasites are abundant. Many or even all of worms may be lost.

11. As in chickens, larvae are carried to ceca.

10. Cecal worms may also be taken in by turkeys. If larval worms and blackhead parasites are present, turkeys may be in grave danger. Poults pick up blackhead-infected eggs of cecal worms on range previously occupied by chickens or older turkeys that had not lost all of their worms.

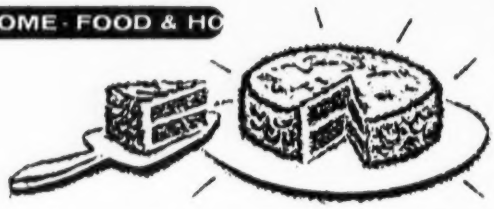
9. Eggs mature after 2 or 3 weeks on moist, warm soil, with tiny worm developing in each fertile egg.

8. Eggs are often fertile but are never mature as they leave bird.

7. Both worms and eggs may be voided in droppings.

6. Female cecal worms develop hundreds of eggs.

5a. If cecal worm eggs contain blackhead parasites, cecum wall becomes infected, swells; thick, white secretion and some blood exude into cecal cavity, often forming core. Chicken usually voids core, ceca heal, and recovery is complete, except that blackhead parasites may remain in cecal cavities, and cecal worms that survived ordeal may carry blackhead parasites.



guides to CAKE FREEZING

Size, icing, and package affect freezing and thawing times, but storage may govern quality

■ CAKES HAVE MUCH greater tolerance to freezing than bread. They don't have to be frozen so fast or so soon after baking. Nor do they have to be defrosted as quickly. But they tend to lose flavor and texture soon after defrosting, much as fresh cakes do when they are stored.

Several types of cakes and breads were stored in USDA rate-of-firming tests at temperatures from 0° to 70° F. Firmness was measured at intervals over a period of 11 days.

The bread was much softer at first than the cake and became firmer much faster at each lower temperature. The cake, on the other hand, became firm at progressively slower rates at each lower temperature level. Chemist J. W. Pence, of the ARS Western Utilization Research and Development Division, Albany, Calif., believes larger amounts of sugar, shortening, and eggs in cakes account for their much greater freezing tolerance.

Actually, many so-called frozen cakes aren't frozen at all. Their freezing points are between 3° and 8° F., and commercial practice is to store them at 5° to 15° F. This is safe up to a week. After that, cakes begin to show substantial quality losses. A temperature of 0° F. or lower is recommended if cakes are to be stored for long periods of time.

It's important to know what moisture changes occur in storing unpackaged and uniced cakes. Actually, they keep original moisture for many weeks if the storage temperature is low enough and the relative humidity high enough. For example, uniced cakes stored for 2 weeks at either 0° or −20° F. and a relative humidity of 80 to 85 percent lost only a few grams of weight. Angel food cakes lost even less. But when relative humidity was 70 to 75 percent, uniced layer and angel-food cakes lost more weight than before and were dry on the surface. In case of doubt as to humidity, it's probably best to ice or package the cakes, Pence feels.

Flavor, texture not affected

Neither freezing itself nor speed of freezing affected texture or flavor. A trained taste panel noticed some flavor *changes*—no off-flavors—in stored frozen cakes. But these changes were very slight and consumers probably wouldn't notice them at all.

Pence says it's absolutely essential to protect cakes against off-flavors and odors from other items in a freezer. Wrapping materials vary in their ability to protect against off-odors. Polyethylene, for example, is superior to some of the other materials.

Wrapping, boxing raise time

Wrapping angel food cakes increased freezing time by 30 percent. Boxing the unwrapped cakes practically doubled freezing time. Wrapper composition made no difference at all. Freezing was delayed, instead, by the air space between wrapper and cake. Therefore, the more snugly a product can be wrapped or packaged, the faster it will freeze and defrost.

Icings have a definite insulating effect. Iced cakes took much longer to freeze and also to defrost.

Cake size also is important in determining freezing and defrosting times. For example, 8-inch layer cakes with fudge icing required 15 percent longer to freeze at −20° F. and 20 percent longer to defrost at 100° F. than 7-inch cakes. Boxing either increased freezing time 50 percent, defrosting time 25 percent. ☆

THERMOCOUPLES help to provide continuous temperature record at three places in cake. Icings have a marked insulating effect. Iced layer cake takes nearly three times longer to freeze than if uniced.

PLASTIC SCREEN bundles both cake halves after sensitive thermocouples have been imbedded deep in center of the layers and in the filling. Electronic recorder keeps track of the cake temperatures.

Does defoliation pay?

Chemical defoliation, used on 3 million acres of cotton, sometimes—but not always—brings economic returns. This was learned in a 3-year study in the Yazoo-Mississippi Delta area by USDA in cooperation with the Mississippi Experiment Station.

Defoliation is profitable when adequate moisture has brought a rank growth and heavily fruited cotton. Under these conditions there is an unusually light natural leaf drop.

But there are usually no advantages when plants are small or are maturing under dry weather. Under these conditions natural defoliation is usually high. Too early defoliation also results in yield reductions.

Where age doesn't count

Age of a nonvaccinated cow does not affect her susceptibility to brucellosis, recent USDA studies show.

This finding is of special significance in brucellosis research because it gives a criterion for selecting suitable experimental cattle—enables effective use of cattle of various ages. This work also gives more accurate standards for immunological study of cattle that have been vaccinated.

In the past, it was generally thought that pregnant heifers were more susceptible to brucellosis than mature cattle. This was because of the high abortion rate among such heifers in infected herds. Therefore, ages of test animals were often considered when interpreting results.

The current work shows that factors other than susceptibility have been responsible for the abortion rates noted. Probably the most significant factor is management. Heifers are usually maintained separately from adult animals of the herd until breeding age. If they are placed with infected animals at this time, heifers receive an initial and usually heavy exposure to *Brucella*. This results in a relatively high abortion rate in the heifers, together with a buildup of brucellosis infection in the herd.

ARS scientists at the Agricultural Research Center, Beltsville, Md., experimentally exposed 86 pregnant cattle between the ages of 2 and 9 years to virulent *Brucella* organisms. Of the 86, 80 were from the brucellosis-free herd at the Beltsville Animal Disease Station and 6 were purchased from nonvaccinated herds certified to be free from brucellosis.

The cattle from outside proved to be much less susceptible to brucellosis than the Beltsville animals. This means that test animals must be of known origin and must be raised under carefully controlled environmental conditions to assure accurate interpretation of research results.

Infection in each animal was evaluated by an arbitrarily assigned scale called the "index of infection." Tests indicated this index showed degree of resistance and susceptibility more clearly than other methods.

New dry bean for West

Columbia Pinto, a new variety of dry bean that has multiple disease resistance, is being grown by some western producers this summer.

The new bean is a close relative of the U. I. No. 78 bean but produces seeds 8 to 10 percent larger. It bears in 85 to 90 days. It's adapted to growing under irrigation in the Yakima Valley, the Columbia Basin, and in parts of Colorado, Nebraska, Wyoming, Montana, and Idaho.

This variety was developed cooperatively by USDA and the Washington and Idaho Agricultural Experiment Stations. It not only has the disease-resistant traits of present varieties but is also resistant to the New York 15 strain of common bean mosaic and some other strains of bean rust. When the New York 15 virus is widespread and susceptible varieties are down 5 to 10 percent in yield, Columbia Pinto yields normally—2,600 to 3,300 pounds per acre in Washington and 2,350 to 2,500 pounds in Idaho, Colorado, Wyoming, and Nebraska.

New sweetpotato snacks

New sweetpotato snacks may soon appear on the market as a result of research at USDA's Eastern Utilization Research and Development Division, Philadelphia. Sweetpotato chips, dice, julienne strips, and frozen french fries were experimentally prepared and found delicious by panels.

The frozen french fries especially showed unusual potential as a commercial food product. They were made with eastern dry-type sweetpotatoes such as Jersey Orange and Maryland Golden varieties. They were fried for 4 to 4½ minutes before freezing, and cooking was completed by oven heating just before serving. The result was a savory product that lost little or no quality during storage.

Color, texture, flavor, and keeping qualities were excellent.

For immediate eating, sweetpotatoes were cut to french-fry size and fried for 5 to 6 minutes at 275° F.

Similar work on the southern yam types has already resulted in prepara-

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tion of sweetpotato chips by the Georgia, Louisiana, and Oklahoma Agricultural Experiment Stations. And the ARS Southern Utilization Research and Development Division, New Orleans, with the Food and Container Institute of the Army Quartermaster Corps, has just prepared hot-air-dehydrated sweetpotato dice.

Researchers hope that commercialization of these deep-fat-fried sweetpotato products will help stem the tide of declining consumption.

Radioactive fallout

Radioactive fallout on the farm is the subject of a bulletin issued recently by USDA. It tells farmers how best to protect themselves, their families, livestock, crops, and land in case of radioactive fallout after a nu-

clear attack. The bulletin was prepared in response to questions from farmers. Single copies of "Defense Against Radioactive Fallout on the Farm," Farmers Bulletin No. 2107, may be obtained without cost from Office of Information, USDA, Washington 25, D. C. (see page 3).

Soybean cyst nematode

Search for the soybean cyst nematode is expected to continue in soybean growing areas until bad weather stops the surveys. Work will continue in the spring. USDA officials are conducting symptom checks, which are followed by soil sampling if suspicious nematodes are found.

Quarantines are established to stop movement of infested soils or products and thereby prevent long-distance spread of these nematodes.

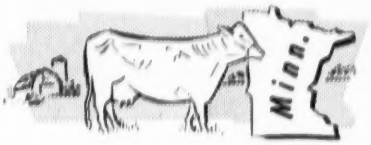
ARS field crews pull weak soybean plants to check roots for cyst nematodes. Cysts found are sent to an identification laboratory in Memphis, Tenn., for prompt analyses.

Soil samples are later collected when more detailed studies are necessary. Examinations are made in the field, and suspicious samples are taken to nearby stations and placed in washing machines. Water is added and floating materials are washed into screens where nematodes are gathered and placed under a microscope. Possible soybean cysts are placed in a preservative and mailed to the laboratory for identification.

Plant pest control officials say soybeans should not be placed in heavily infested fields since this will increase nematodes, damage soybean crops, and encourage dispersal.

Minnesota brucellosis free

The State of Minnesota has been declared modified certified brucellosis free. This means that the disease is present in not more than 1 percent of the State's cattle and not more than 5 percent of the State's herds. Minnesota is the seventh State—the second this year—to achieve modified certified status in the nationwide program to eradicate brucellosis. Other



States are Delaware, Maine, New Hampshire, North Carolina, Wisconsin and Washington. Also, 374 counties in 26 other States and in Puerto Rico have gained this status.

Irradiating farm products

Radioactive cobalt (cobalt 60) will soon be used by USDA scientists to speed research into new uses for cotton and other crops. Plans call for radiation treatments to help improve or create useful products from cottonseed, pine gum, tung oil, castor oil, fruits, and vegetables.

Researchers have made much progress toward increasing the demand for cotton through physical and chemical modification of cotton cellulose. Cobalt is expected to provide a fast and accurate way to tell how many of these modifications affect cotton's chemical reactivity and physical properties. It will also be used to measure absorption and adhesion of dyes to the cotton, and to obtain other information on cotton fiber's behavior under various conditions.

Chemist J. C. Arthur, of USDA's Southern Utilization Research and Development Division, New Orleans, is in charge of this research.

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